

Notes on King-Crabs (Xiphosura)

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Since the publication of my previous note (1), I have seen two papers bearing on this subject and published at about the same time, by Dr. Ch. Gravier of the Museum National d' Histoire Naturelle in Paris (2 and 3). I cannot agree with several of his conclusions. The following notes are based on the material previously recorded by me (1), on a further adult specimen of *Carcinoscorpius rotundicauda*; and on two adult males, a large female and an immature specimen, probably male, of *Tachypleus tridentatus*, from Hong Kong presented to the Raffles Museum by Dr. G. A. C. Herklots, of the Department of Biology, University of Hong Kong.

In this account of the caudal appendage (2), Dr. Gravier has given a key for the identification of the known species by examination of this organ alone. It runs as follows:—

A l'appendice caudal	{ une gouttière ventrale	bien marquée; des épines sur toute la longueur de l'arête dorsale et sur le tiers antérieur des arêtes latérales..... <i>Tachypleus tridentatus</i> (Leach.)
		légèrement marquée et sur la moitié postérieure seulement; des épines de dimensions décroissantes d'avant en arrière sur la moitié antérieure de l'arête dorsale; pas d' épines sur les arêtes latérales <i>T. gigas</i> (Müller); quelques épines sur l'arête dorsale; quelques dentelures sur les arêtes latérales <i>Xiphosura polyphemus</i> (Linné).
	{ pas de gouttière ventrale	Ni épines, ni dentelures sur les arêtes qui sont toutes mousses <i>Carcinoscorpius rotundicauda</i> (Latr.)."

With regard to the ventral groove, Dr. Gravier may have confused the two species of *Tachypleus*. All my specimens of *Tachypleus gigas* have a well-marked groove extending practically the whole length of the appendage, and not only in the posterior half, in both sexes. In *T. tridentatus* the groove is not so well-marked and may be lacking either posteriorly or anteriorly or both.

The spines on the dorsal crest are somewhat irregular in length in both species; there is a tendency towards decrease in length posteriorly, though longer spines project at intervals. These spines extend the whole length of the appendage.

Spines are present on the anterior portion of the lateral borders of the caudal appendage of *T. tridentatus* in one male and one female of the Hong Kong material; they are totally lacking in the other male, the immature specimen, and in the previously recorded female from Sarawak. This is an aberration of the same order as the

presence or absence of the spine on the lateral crest bordering the gill-chamber on the ventral surface of the opisthosoma in *Tachypleus gigas* and *Carcinoscorpius rotundicauda*, and like it is not related to size or age. There may be some relation between the presence or absence of spines and the type of bottom on which the individual is living. The smooth-edged caudal appendage of the male referred to above is rather longer than the carapace; in the specimen with spines on the lateral crests, the appendage is considerably shorter. In the larger of the Hong Kong females the end of the caudal appendage is buckled as though it had been called upon to perform its function as a lever too soon after the moult, whilst the chitin was not fully hardened.

The difference in form of the anterior margin of the carapace in the male and female of *T. tridentatus* is very marked. The portion between the two excisions is deeply excavate, as may be expected from the method of copulation, in which the ventral surface of the male and the dorsal surface of the female are apposed. The anterior margin outside the excisions is reflected upwards and backwards. Also related to the copulatory process is the compression of the median spine on the anterior ventral surface of the prosoma, which in the female projects ventrally in a very pronounced manner.

A similar but less marked indentation and reflexion is present in the males of *Tachypleus gigas* and *Carcinoscorpius rotundicauda*, but there are no lateral excisions; the median spine is somewhat compressed and less developed in the males. The degree of adaptation in the male King-Crab would therefore appear to bear some relation to size. Of the smaller species we have *Carcinoscorpius rotundicauda* with two pairs of chelate but modified claspers, and *Limulus polyphemus* with one pair of hemichelate claspers. *Tachypleus gigas* has two pairs of hemichelate claspers, and the same condition is also found in *T. tridentatus* with the addition of the two excisions in the anterior border of the carapace which allow of a firmer hold; a like advantage accrues from the more deeply excavate median portion.

The genital operculum of *T. tridentatus*, whilst varying considerably in the extent to which the internal branches are separated at the tip, conforms in all my specimens to Pocock's characterization of the genus (4, p. 262).

Attention must be drawn to the following possible errors in identification of Dr. Gravier's specimens:—

1. The specimen collected by Marche in Philippine waters and placed by Dr. Gravier under *T. gigas* (3, p. 319 and 2, p. 94) appears both from its size, totalling 72 cm., and from the northerly locality, to be an example of *T. tridentatus*. In large females of this species the spines on the posterior border of the opisthosoma, from which the specific name is derived, may be somewhat indistinct.

2. Examples placed under *T. tridentatus*, numbered V and VI, from Batavia, appear to have exhibited no characters to justify their inclusion here, and are possibly *T. gigas*. This view is borne out by the photograph of one, a male (3, p. 327). Similarly specimens VIII (b), (c) and (d) are almost certainly *T. gigas*. The respective localities, Siam, Mer des Indes, and Batavia are all outside the known range of *T. tridentatus*.

I have mentioned the above instances in order to dispel any misconception they may raise as to the ranges of the species.

A few noteworthy points occur with regard to the fresh material of *Tachypleus tridentatus* from Hong Kong.

In the female the fourth moveable spine on the left of the opisthosoma, instead of being short and truncate as usual in this sex, is long like that of a male; the tip is broken. The corresponding spine on the right is bifid and gives rather the impression that spines of both male and female type were developing and had fused as they became impacted.

The sixth prosomatic appendage on the right side of the same specimen has probably been lost and regrown as it is much smaller than its fellow; there are only three sclerites at the apex of the penultimate segment instead of four, and the sixth segment only slightly protrudes beyond these. There is a small moveable spur in addition to the larger one usually found at the apex of the fourth segment.

Shipley (5, p. 260) comments on the "self-respecting, well-groomed appearance" of King-Crabs, and this condition is one which may be expected in a burrowing animal, without necessarily postulating a secretion, as does Shipley. Most of the examples which I have seen bear this out, but the two large males from Hong Kong are exceptional. The ventral surface and appendages, in both specimens, are liberally supplied with *Polyzoa* and some barnacles both of the stalked and sessile types, and whilst the dorsum of one specimen is moderately clear, that of the other is thickly encrusted. A full-grown male of *T. gigas* is in a similar state. It seems possible that these are old males, less actively burrowing than younger individuals.

In both sexes the carapace, and particularly the opisthosoma, is liberally sprinkled with small spines. An anonymous note which recently appeared in the China Journal of Arts and Sciences (7) is accompanied by a photograph of the male and female of *T. tridentatus* (under the name *Xiphosura longispina*). Curiously enough the correspondent has chosen for his exposition a female which is abnormal in having all the moveable spines of the opisthosoma long, as in the male.

Dr. Gravier refers (3, p. 314, footnote) to several cases, both in *Tachypleus tridentatus* and in *T. gigas*, in which occur what he calls "anomalies de developpement". As these are cases where

one of the posterior points of the carapace is affected, they are probably exactly similar to those which I have noticed in my previous paper (i. p. 77). I cannot agree with Dr. Gravier when he says "la cause de ces anomalies de croissance existait, sans doute, en puissance dans l'oeuf". They appear to me to be much more satisfactorily explained as the result of attacks by enemies. The wounded edge closes and heals; the new spine is developed at that point where the edge of the wound meets that branch of the nerve which supplied the old spine, and is therefore developed rather toward the inner than the outer margin of the prosoma (cf. 1, fig. 4, and 5, fig. 156). I had hoped to confirm this by dissection, but have been unable to obtain a specimen thus damaged suitable for the purpose. The healed surfaces do not appear to me to differ in any way from those of other undoubted wounds. Abnormalities such as the double caudal appendage recorded by Dr. Gravier (6)¹, or the appearance of the secondary sexual characters of one sex in specimens of the other, instances of which have been quoted both by Dr. Gravier and by myself, may much more safely be asserted to have their origin in the egg.

With regard to *Carcinoscorpius rotundicauda*, this species is always readily distinguished by the smooth, round caudal appendage. It is true, as Dr. Gravier remarks (3, p. 318) that the prosomatic appendages are chelate in both sexes, but the adult male is easily detected by the greatly swollen propodites of the claspers. A male from Pulau Bulang, Rhio Archipelago has claspers which are markedly different from those of the female, more accentuated than those of the specimen figured by me (1), and intermediate between that and the figure given by Pocock (4).

REFERENCES

1. Smedley, Bull. Raffles Mus., 2, 1929, pp. 73-78.
2. Gravier, Bull. Mus. Nat. Hist. Nat. (2) I, 1929, pp. 94-99.
3. Gravier, tom. cit., pp. 313-331.
4. Pocock, Ann. Mag. Nat. Hist. (7), IX, 1902, p. 256 et seq.
5. Shipley, Camb. Nat. Hist., IV, 1909, pp. 260-261 and p. 272.
6. Gravier, Bull. Mus. Nat. Hist. Nat. (2) II, 1930, pp. 89-91.
7. Anon., China Journ. Arts and Sciences, IX, 5, 1928, p. 252.

Errata (Bull. Raffles Mus., 2, 1929, pp. 73-78).

I take this opportunity to correct the following errors in transcription in my previous paper:—

- p. 75 line 16—for "Lyddeder" read "Lydekker".
 p. 75 lines 28 and 32 for "opisthoma" read "opisthosoma".
 p. 76 line 3— " " " "
 p. 77 line 9— " " " "
 p. 78 lines 25 and 28 " " " "
 p. 77 line 15—for "exceeding" read "of".

¹ The locality of this specimen is erroneously stated; by "Kuchiry River" should doubtless be understood "Kuching River".